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FALX CEREBRI.

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At a time when rapidly increasing knowledge of the etiology of disease is daily disclosing new possibilities of preventive medicine, no one can fail to hope for some new light upon the causation of malignant tumors. One after another pathologists have essayed the solution of this most hidden problem, and their repeated failures serve only to emphasize the paucity of material from which to educe a satisfactory theory. Generalization without facts is impossible. Facts, then, are what are needed to-day, and facts in medicine are carefully reported cases. It is in the hope that some suggestion may be contained in it that the following case is presented.

I desire here to express my indebtedness to Drs. Robert A. Murray and Farquhar Curtis, surgeons in charge of the case, for the use of the clinical history, and to Dr. John S. Thacher, pathologist to St. Luke's Hospital, for the account of the autopsy and the specimens.

Charles H., a German, aged thirty-nine, single, a laborer by occupation, presented himself at St. Luke's Hospital on July 16, 1889, complaining of a painful tumor of the right testicle. Twenty years before he had ruptured himself while carrying a heavy weight, and had since that time worn a truss. During the previous winter he had been obliged to provide himself with a new truss, which fitted badly, causing him much discomfort and considerable irritation of the parts. This was worn for several months until he could endure it no longer. About the middle of April he noticed that the right testicle was tender, harder, and somewhat larger than before, and about two months before admission to the hospital he noticed a hard mass extending upward and outward from the testicle, to which it appeared to be attached. He stated that this tumor had been separable from the hernial tumor, which was always easily reducible. Incomplete descent of the right testicle existed during childhood, the organ lying in the inguinal canal. This condition persisted until he began to wear the truss, by which the testicle had been prevented from retracting.

Patient said that he had been very healthy, that he was only a mod-

erate drinker, and had never contracted either gonorrhœa or syphilis. No evidence of renal, pulmonary, or cardiac disease. Family history negative.

Examination disclosed a hard, nodular, tender mass in the right scrotal sac about four inches long and one and one-half inch in diameter, running upward to the inguinal canal. External to and above this mass was the sac of a reducible inguinal hernia.

On July 18th Dr. Murray operated, amputating the diseased testicle and sewing up the sac for the radical cure of the hernia. Recovery after the operation was rapid, and on August 27th the patient was discharged, apparently well.

Examination of the amputated testicle by Dr. Thacher showed it to be enlarged ($1\frac{3}{4} \times 1\frac{1}{4} \times 1\frac{1}{4}$ inches), rather firm in consistence, and of a mottled appearance on section. The epididymis was also enlarged to a diameter of $\frac{7}{8}$ of an inch, and on section presented a white surface dotted by several minute soft dark spots. Microscopic examination of the testicular tumor showed it to consist of a connective tissue stroma containing an abundance of irregularly shaped alveoli filled with cells, which are described as round or polyhedral in shape (except those at the periphery of the alveoli, many of which were cylindrical), and as completely filling the sharply outlined alveoli. The diagnosis *carcinoma testis* was returned.

For two months after leaving the hospital patient felt very well and was able to do light work, the hernia not returning. Toward the end of October, however, he began to experience gradually increasing pain in the right inguinal region, and soon a tender tumor was appreciable in the same location. Loss of flesh and strength followed, his appetite failed, and he began to be much annoyed by constipation.

On December 13th he applied for readmission to the hospital. The tumor was found to extend upward as far as the level of the anterior superior spinous process of the ilium, and inward to the external border of the rectus abdominis muscle. It was hard, nodular, and tender.

Five days later laparotomy was performed by Dr. Farquhar Curtis. Enlarged lymphatic glands were found along the course of the spermatic cord, and a mass of considerable size lay against the lumbar vertebræ. It was thought inadvisable to attempt the removal of any of the tumor and the abdominal wound was accordingly closed.

On the 22d he complained of pain in the chest and cough, and signs of general bronchitis and consolidation of the lower lobe of the left lung developed, with considerable rise of temperature and blood-streaked sputum. Poultices were applied and ammonium carbonate and whiskey were administered. This condition continued five days, after which the signs of pneumonia disappeared. The bronchitis continued, however, until his death, as did an irregular temperature, ranging up to $103\frac{1}{2}^{\circ}$ at times. Pain in the region of the tumor now became a distressing symptom, necessitating the free use of morphine. Thus he continued, gradually declining, until January 20, 1890, when, after a chill, signs of consolidation of the middle of the left lung posteriorly made their appearance. From this time he steadily weakened, and died on February 9th.

Autopsy (thirty-six hours after death, by Dr. Thacher, from whose report I quote).—Small frame; muscular development slight; adipose extremely scant. Diaphragm: right, fifth rib; left, fifth rib.

Left lung: Many old adhesions. Very numerous nodules scattered through the lung varying in size up to one and one half inch in diameter, most of them white with reddish spots, and mostly well circumscribed, but in the lower part of the lower lobe there is much diffuse infiltration of white tissue. The majority of the nodules are of encephaloid consistence, but some are a little firmer and a few are broken down, and contain a thick, reddish fluid. In the upper lobe there is some thick cicatricial tissue and a few patches of broncho-pneumonia are visible, besides a few clusters of small tubercles and some small cavities or dilated bronchi filled with pus. Weight, 2 pounds 5 ounces.

Right lung: Many old adhesions; very many nodules similar to those in the left lung, wholly circumscribed. At the apex much cicatricial tissue and many gray tubercles. Weight: 2 lbs. 13 ozs.

Bronchial glands enlarged and contain light nodules of cheesy consistence.

Heart: Fat scant; muscle pale; valves normal. Weight: 9½ ozs.

Liver: Slight nutmeg appearance. Gall-bladder contains a little black bile. Weight: 3 lbs. 13 ozs.

Pancreas small; no lesion. Weight: 1½ oz.

Left kidney: Ureter and supra-renal capsule normal. Capsule non-adherent; surface smooth, stars congested, a little pale between. On section cortex somewhat opaque and congested. Weight: 4½ ozs.

Right kidney presents same appearance as left, except that ureter and pelvis are much distended, and the congestion of the cortex is more marked. Weight: 4 ozs.

Mesenteric glands are slightly prominent, firm and white.

Stomach: In the cardiac portion near the larger curvature is a mass resembling the other tumors, apparently in the submucous coat. On section this is found to consist of two small nodules, each about one-quarter inch in diameter, of soft consistence. The stomach contains much mucus. Weight: 5½ ozs.

Intestines: Lower part of ileum and the large intestine much contracted; some moderate congestion in places.

Bladder a little congested. Prostate normal. Seminal vesicles distended. Left testicle normal.

A mass of nodular growths, one to one and a half inch in diameter, lies along the psoas muscle and vertebral column from Poupart's ligament to the diaphragm. A few isolated nodules lie along the thoracic vertebræ. The mass in the pelvis envelops in great part the large vessels there, and in the lower portion of the vena cava inferior and in the right common iliac vein there are firm clots, somewhat adherent in spots, gray and soft. A few small nodular growths project into the vena cava; some of these appear ulcerated.

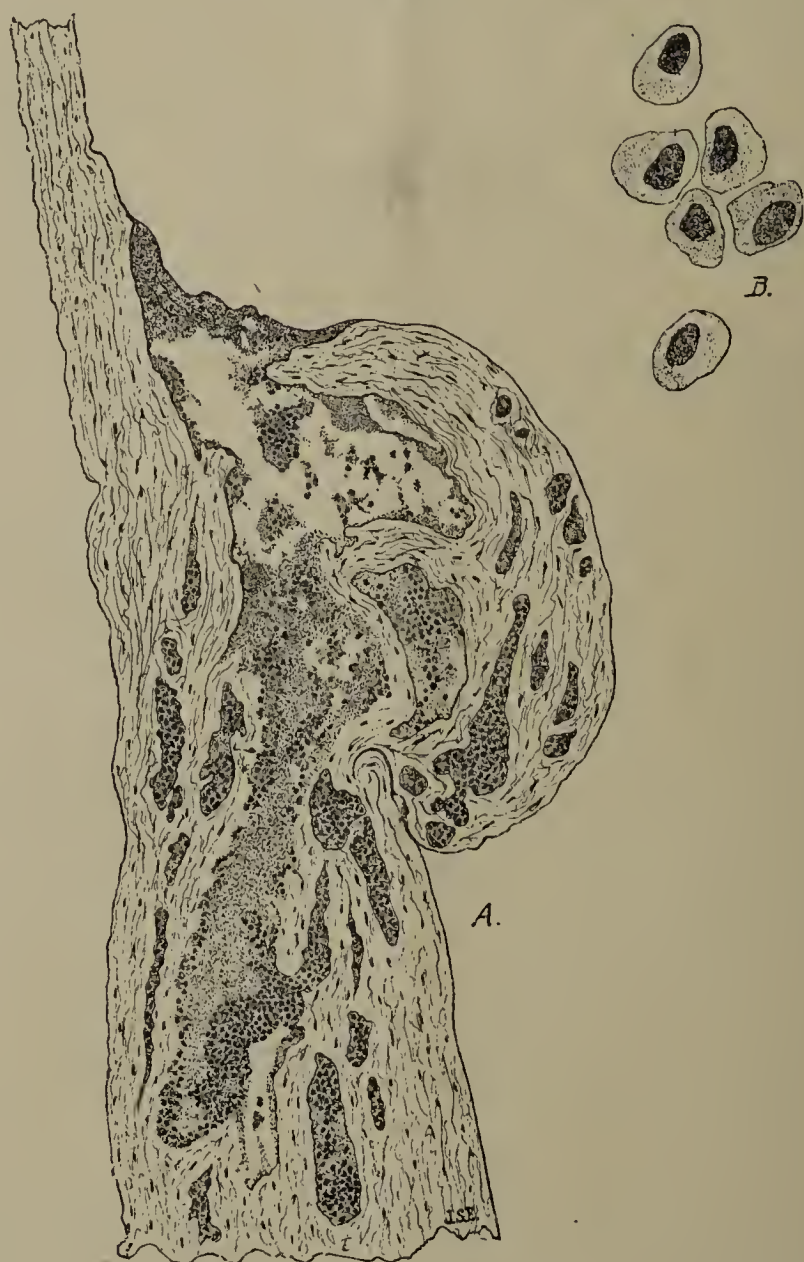
Brain: In the falx cerebri, about one and one-half inch from the anterior end, is a tumor one inch in diameter, irregularly nodular, and of encephaloid consistence, reddish exteriorly, but gray in centre. Brain otherwise normal. Weight: 2 lbs. 11½ ozs.¹

Microscopical examination of portions of the neoplasm from the pelvis, stomach, lungs, and bronchial glands shows the structure to be essentially the same in all. In a firm connective tissue stroma are many irregularly

¹ The specimens from this case are in the Museum of the College of Physicians and Surgeons, New York, Nos. 924-927.

shaped alveoli, each sharply outlined and filled with a mass of round and polyhedral cells, having rather voluminous cell bodies and large nuclei, and heaped in the alveoli without supporting reticulum of any sort. These cell-nests are, many of them, of considerable size, and are very abundant, while the stroma is rather meagre in amount, stamping the tumors as medullary or encephaloid carcinomata.

FIG. 1.



A. Carcinomatous nodule growing on right wall of vena cava inferior and projecting into its lumen. Many alveoli are visible, filled with epithelial cells or their débris. Above is a rupture of the wall of the nodule, closed now by a thrombus, through which some of the softened cancerous material has escaped into the lumen of the vessel. [$\times 12$. The cells are represented proportionately somewhat too large.]

B. A group of the carcinoma cells from the same specimen. [$\times 500$.]

Similar examination of one of the small nodular growths projecting into the vena cava inferior shows it to be in direct continuity with a carcinomatous mass surrounding the vessel, through the wall of which it has evidently grown. In its centre is a cavity containing remnants of soft carcinoma tissue, but the greater part of its contents has been discharged into the lumen of the vein through an evident rupture of the nodule at its upper part, now closed by a loose clot. The accompanying drawing (Fig. 1) has been made from the specimen.

In the lungs many of the smaller bloodvessels are plugged by masses of epithelial cells, similar in every particular to those described as occupying the alveoli of the cancerous tissue in the various organs. They must be regarded as emboli of carcinomatous material, demonstrating that the blood current has been, in the present case, the transporter of much of the infectious material from which metastases developed (Fig. 2).

FIG. 2.



Group of bloodvessels in the lung, two of which are plugged by emboli of cancerous material. The tissue of the lung in the immediate neighborhood is somewhat infiltrated with small spheroidal cells, and there is broncho-pneumonia. The other two bloodvessels contain ordinary clots. [$\times 50$.]

We have, then, a case of primary encephaloid carcinoma of the right testicle with secondary growth along the course of the lymphatics of the pelvis and spine, involvement of the vena cava inferior, growth through its wall, infection of the blood, and metastases in the lungs, stomach, and falx cerebri. The picture, as a whole, is not unusual. Carcinoma of the testicle, though not of as frequent occurrence as sarcoma of that organ, is by no means rare, is usually of encephaloid variety, commonly affects but one gland, and frequently follows traumatism of some kind. Its mode of extension, too, is usually that exemplified by the present case, along the lymphatics accompanying the spermatic bloodvessels, and an almost constant sequel is the formation of metastases. One feature of the case, however, demands consideration: metastasis in the stomach.

Striking verification of Virchow's aphorism that tumors occur most rarely as metastasis in those organs in which, as primary growths, they appear most often, exists in the relative frequency of primary and metastatic carcinomata of the stomach. As is well known, the stomach is one of the most frequent sites of primary cancer: metastasis in its wall is, on the other hand, a great rarity. Among statistics, tabulated by Coup-

land ⁽¹⁾, of 89 cases of carcinoma primary in the mamma, collected from the records of the Middlesex Hospital for the years 1867 to 1875, mention is made of only one metastasis in the stomach. Török and Wittelschöfer ⁽²⁾, in reviewing the records of the Vienna Pathological Institute, between the years 1817 and 1879, found reports of 366 cases of carcinoma of the mamma, of which there had been formation of metastasis in 220, but in only 8 was the stomach a site. Again, among more than 600 cases of carcinoma in all locations autopsied at the Berlin Pathological Institute, Grawitz ⁽³⁾ was able to find record of metastasis in the stomach in only 3¹. These statistics suggest the frequency of metastatic carcinoma of the stomach to be about 1.1 per cent. of all cases of cancer.

Beside these statistics, there are in the literature more or less full records of 13 cases of metastatic carcinoma of the stomach. To a hasty review of these I ask attention, since from their study it is possible to deduce an explanation of the mode of production of metastases in the stomach, the truth of which is confirmed by the present case.

I. The earliest observation of metastatic carcinoma of the stomach, of which I am able to find record, is reported by Cohnheim ⁽⁴⁾. The primary tumor (scirrhus) was located in the breast, and many metastases are reported in different organs, among others in the stomach, where fourteen small cancerous masses were found scattered along the greater curvature near the pyloric extremity.

II. In 1876 Weigert ⁽⁵⁾ reported an exceedingly interesting case of epithelioma of the leg, not diagnosticated until after death, when metastatic growths were found distributed along the course of the pelvic and lumbar lymphatics and in nearly all the abdominal and thoracic viscera. The widespread distribution of the secondary tumors received explanation by the discovery of rupture into the vena cava inferior of a cancerous mass situated about the right supra-renal capsule, the infectious material thus finding entrance to the circulation. The metastasis in the stomach was situated at the fundus near the greater curvature, was about an inch in diameter and had ulcerated through the mucous membrane.

III. To the cases already cited four others were added by Grawitz ⁽⁶⁾ in 1881. In the first the primary tumor was an ulcerated epithelioma of the œsophagus. Two metastases, the only ones in the body, were found in the stomach. The first, about the size of a goose egg, ulcerated on its surface, was situated near the œsophageal orifice, involved all the coats of the stomach, and was connected with enlarged and cancerous lymph glands in the neighborhood. The second—smaller—lay near the first on the lesser curvature. There was in addition a simple ulcer of the stomach.

IV. In the second case the œsophagus was again the site of the primary tumor (epithelioma, ulcerated), which had penetrated into the pleural cavity, causing fatal pleurisy. Near the œsophageal opening was a large carcinomatous mass, ulcerated, involving all the layers of the stomach wall. Besides this, the only other metastasis was a small tumor in the liver.

V. Grawitz's third case is one of primary encephaloid carcinoma of the testicle. The stomach was dilated and on its anterior wall, midway between the fundus and pylorus, was a round metastasis about the size of a "plum," slightly ulcerated, occupying the mucous and submucous coats, and freely movable on the muscular. A second metastasis, smaller, on the greater curvature near the first, occupied the submucous coat only. Many meta-

¹ One of these had previously been reported in detail by Cohnheim (see Case I.).

stases were found in other organs—in the lungs, pleuræ, liver, kidneys, suprarenals, intestine, and thyroid gland.

VI. His fourth and last case, was a recurrent scirrhus of the breast in a woman sixty-nine years of age. The stomach contained six rather flat tumors, about one-half inch in diameter, of rather dense consistence, and confined to the submucous coat; none of them being ulcerated. This case is further noteworthy because of the great number of metastases in nearly every organ of the body, and especially in the large nerve-trunks of the brain and spinal cord. Involvement of the large veins near the heart was discovered, and small metastatic tumors were found in the interauricular septum.

VII. In 1882, in reviewing the records of the Leyden Clinic for about ten years, van Haren Noman (⁷) unearthed accounts of five additional cases of carcinoma of the stomach supposed to be metastatic, but, as the findings in his second case do not appear to me to warrant this conclusion, I shall mention the others only. The first was a case of primary carcinoma of the œsophagus at the level of the cricoid cartilage. It was ulcerated, and immediately below it was a large cauliflower excrescence nearly occluding the gullet. Below this the œsophagus was normal. In the stomach near the cardiac orifice was a metastasis about the size of a pea. This was the only metastasis in the body.

VIII. The third case was that of a man, nineteen years of age, who died of a large carcinoma of the left suprarenal capsule. The submucosa of the stomach was found to contain a number of metastatic tumors about the size of peas, over which the mucous coat was freely movable. Other metastases existed in the liver and peritoneum.

IX. The fourth case is that of a woman, thirty-five years old, whose pelvis was filled with a carcinomatous mass apparently originating from the rectum. The process extended upward through the lymphatics along the spine. A small ulcerated metastasis was found on the lesser curvature of the stomach.

X. Noman's fifth case was an ulcerated epithelioma of the œsophagus. Numerous metastases are recorded—in the liver, bones, and in the wall of the stomach.

XI. Two years later, in 1884, a case of primary epithelioma of the œsophagus was reported by Beck (⁸). The tumor ulcerated through the trachea, and the patient died of secondary gangrene of the lungs. In the stomach a metastasis was found, which Beck attributes to the implantation of carcinoma cells swallowed from the ulcerated tumor of the œsophagus.

XII. Finally, during the past year two additional cases have been reported by Zahn (⁹). In the first, the primary tumor (scirrhus) was situated in the left breast, the lymph-glands of the axilla being secondarily involved. A dense metastasis was found at the pyloric end of the stomach, in the submucous and muscular coats. Other metastases occurred in the omentum, peritoneum, ileum, colon, pancreas, and adventitia of the aorta. Zahn believes the transfer of infectious material, giving rise to the metastases, to have taken place through the bloodvessels.

XIII. In the second case, an ulcerated epithelioma occupied the wall of the œsophagus at about the level of the bifurcation of the trachea. Below this the œsophagus was apparently normal. Three small tumors, about the size of peas, in the wall of the stomach, were the only metastases to be found. These were all situated in the fundus.

These thirteen cases, with that here reported for the first time, may be conveniently tabulated as follows:

TABLE OF CASES OF METASTATIC CARCINOMA OF THE STOMACH.

Case.	Site of primary tumor.	Variety of primary tumor.	Metastases in stomach; number and situation.	Metastases in other organs.	Involvement of bloodvessels.
I. Cohnheim,	Mamma.	Scirrhus.	14, scattered along greater curvature near pylorus.	Very many.	
II. Weigert,	Leg.	Epithelioma.	1, at fundus, near greater curvature.	In nearly all the thoracic and abdominal viscera.	Rupture of cancerous mass into vena cava inferior.
III. Grawitz,	Œsophagus.	Epithelioma, ulcerated.	2, first near œsophageal orifice, ulcerated; second near by on lesser curvature; in addition, simple ulcer.	None.	
IV. Grawitz,	Œsophagus	Epithelioma, ulcerated.	1, near œsophageal opening ulcerated.	Small metastasis in liver the only other.	
V. Grawitz,	Testicle.	Encephaloid carcinoma.	2, first on anterior wall, about middle; second, on greater curvature.	Many, in lungs, liver, kidneys, suprarenals, intestine, thyroid gland.	
VI. Grawitz,	Mamma.	Scirrhus.	6, confined to submucous coat.	Very many, in nearly every organ of body.	Large veins of thorax involved.
VII. Noman,	Œsophagus.	Epithelioma(?) ulcerated.	1, near œsophageal orifice, about size of pea.	None.	
VIII. Noman,	Suprarenal capsule.	Carcinoma.	Several small metastases in submucous coat.	Numerous, in liver and peritoneum.	
IX. Noman,	Pelvis (rectum?)	Carcinoma.	1, small metastasis on lesser curvature.	?	
X. Noman,	Œsophagus	Epithelioma, ulcerated.	One	Numerous, in liver, bones, etc.	
XI. Beck,	Œsophagus.	Epithelioma, ulcerated.	One.		
XII. Zahn,	Mamma.	Scirrhus.	1, at pyloric end of stomach.	In peritoneum, ileum, colon, pancreas, adventitia of aorta.	
XIII. Zahn,	Œsophagus.	Epithelioma, ulcerated.	3, in fundus.	None.	
XIV. Ely,	Testicle.	Encephaloid, carcinoma.	2, in submucosa, near greater curvature.	Very many in lungs, in falx cerebri, along pelvic and lumbar lymph vessels.	Ingrowth of tumor into vena cava inferior, and discharge of infectious material into its lumen.*

It will be seen, from an inspection of this table, that the cases belong to two distinct sets; first, that in which the tumor in the stomach was the only, or almost the only, metastasis in the body; and, second, that in which many metastases were present in other organs. This difference at once suggests a different mode of infection in the two classes of cases, and on returning to the table we are struck by the fact, that in all the cases in which the tumor in the stomach was the only metastasis the primary tumor was situated in the œsophagus. These facts together suggest the possibility of direct transfer of portions of the primary tumor through the œsophagus to the stomach and engraftment upon its mucous membrane, in this way giving origin to a secondary growth. So accustomed are we to think of the blood- and lymph-vessels as the channels of transmission of cancerous material that the possibility of any other is apt to be overlooked. In the present instance, however, the anatomical arrangement of the lymphatics of the œsophagus is such as to make any transfer of material through them to the stomach practically impossible. Arising from a plexus lying in the submucosa of the gullet, the lymphatic trunks perforate the muscular wall and terminate in the glands of the posterior mediastinum, which in turn discharge into the thoracic duct. Only through occasional anastomoses of capillaries of the lymphatic plexus in the two organs is there any connection between the lymphatics of the œsophagus and stomach. The same difficulty stands in the way of crediting the bloodvessels with the transmission of the infectious material in these cases, for the circulation in the two organs is quite distinct. The possibility of such transfer through the bloodvessels is, of course, not to be denied (it is exemplified, I believe, in Case X.), but in such cases it is scarcely conceivable that there should be metastasis in the stomach only—a striking feature of the group of cases of which we are speaking.

As no reference is intended in this paper to cases of secondary involvement of the stomach by growth by continuity from other organs (such cases having been carefully excluded), the only remaining channel of communication between œsophagus and stomach is the lumen of these organs themselves. In favor of the view that this is in reality the path of transmission of infectious material in these cases, are the well-known tendency of œsophageal cancer to ulcerate, thus affording ample material, and the situation of the metastatic growths in the cardia of the stomach near the œsophageal opening. But, if we are to accept this theory, the possibility of engraftment of carcinomatous material upon a mucous membrane must be admitted. Notwithstanding many failures, a few measurably successful inoculations of carcinomatous material in animals are on record ⁽¹⁰⁾, and, in estimating the significance of negative results of inoculation experiments, the necessary existence of certain predisposing conditions before infection can occur should not be

forgotten. That these predisposing conditions are rarely present, is shown by the rarity of metastasis in the stomach in cases of carcinoma of the œsophagus. Among forty-two such cases collected by Petri (¹¹), in only two was there metastasis in the stomach.¹ Furthermore, there are a number of cases of metastatic cancer on record apparently inexplicable on any other theory than that of engraftment of infectious material on a mucous surface, and among these I am inclined to class most cases of primary cancer of the œsophagus with metastasis in the stomach.

Let us now turn to a consideration of the conditions in the second set of cases which our table presents. It will be remembered, that in the cases forming this group metastases were widely distributed throughout the body. Dissemination of the infectious material through the blood or lymph vessels is consequently at once suggested, and that one of these must, in fact, be the channel of spread of the disease is confirmed by the remoteness of the primary tumor from the stomach.

The anatomical arrangement of the lymphatics of the stomach is such as to render the possibility of transmission of infectious material to it through them extremely remote. Arising in the wall of the stomach they pass upward and downward over its surface to the lesser and greater curvatures, respectively, where they enter a few small lymph nodes lying along the attached borders of the corresponding omenta. The lymphatics of the lesser curvature accompany the coronary vessels to the cardiac orifice, and then turn downward behind the pancreas to enter the cœliac glands; those of the greater curvature pass toward the pylorus, accompanying the right gastro-epiploic artery, and after being joined by lymphatics from the upper portion of the duodenum, also pass into the cœliac glands. A third series of lymphatics proceed from the left end of the stomach, and, following the course of the gastric branches of the splenic artery, unite with the lymphatics of the spleen. (Quain.) Now, the circulation in all these lymphatics is *away from* the stomach, not to it. If, therefore, we suppose infectious material to be carried to the stomach through the channel of its lymphatics, we must also suppose it to be transported in opposition to the current of the contained lymph and against the resistance of the valves of the lymph vessels—a supposition highly improbable in view of the fact that the lymph current itself is the transporting agent. Furthermore, in such transport, if it were possible, certain lymph nodes would necessarily be passed before the infectious material could reach the stomach, and these have, in most cases of metastatic carcinoma of the stomach, been found to be uninvolved in the new growth. In the present case, examination shows them to be healthy.

¹ These statistics are included in those of Grawitz referred to above.

Besides this negative evidence, we are in possession of certain facts distinctly in favor of the view that the blood-current is the transporting agent in this second group of cases. In the first place, these metastases are usually found on either the greater or lesser curvature, or very near them—directly in the course of the arterial supply of the stomach. Secondly, in a number of cases involvement of large veins in cancerous masses in various parts of the body has been discovered—positive demonstration of infection of the blood in these cases. And, finally, in this second group of cases other metastases, inexplicable apart from the theory of infection through the bloodvessels, are numerous in nearly every case.

As the result, then, of our study, we conclude that metastatic carcinoma of the stomach may arise in one of two ways: first, by implantation of carcinomatous material transported through the œsophagus from ulcerated cancer higher in the alimentary tract; and, second, by transport of infectious material from a distance through the blood-current; and that the lymphatics must be an extremely rare channel of transport of infectious material of any kind to the stomach.

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